

UNITED STATES MARINE CORPS
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STUDENT HANDOUT

FRESH WATER PURIFICATION UNIT (3000 LMT)

1. Terminal Learning Objectives:

a. Provided a Fresh Water Purification Unit (3000 LMT), fuel, a water source, earplugs, and references, operate the unit in accordance with TM-09777A-14/1 and TM-01034D-12&P1. (1171.02.06)

b. Provided a Fresh Water Purification Unit (3000 LMT), fuel, a water source, earplugs, and references, perform preventive maintenance on the unit in accordance with TM-09777A-14/1. (1171.04.06)

2. Enabling Learning Objectives:

a. Given the necessary equipment, a water source, tools and materials, without the aid of references, set up the unit in accordance with TM-09777A-14/1 and TM-01034D-12&P. (1171.02.06a)

b. Given the necessary equipment, a water source, tools and materials, without the aid of references, conduct operator maintenance in accordance with TM-09777A-14/1. (1171.04.06a)

c. Given the necessary equipment, a water source, tools and materials, without the aid of references, start the unit in accordance with TM-09777A-14/1. (1171.02.06b)

d. Given the necessary equipment, a water source, tools and materials, without the aid of references, shut down the unit in accordance with TM-09777A-14/1. (1171.02.06c)

BODY

1. Characteristics and capabilities:

a. The Fresh Water Purification Unit (3000 LMT) is a frame mounted, skid based, diesel operated, diatomite type unit capable of purifying a fresh water source (less than 1,500 TDS) at a rate of 3000 gallons per hour. The unit was designed to be transported by tactical vehicle or air lifted by helicopter to remote sites. The unit weighs 680 lbs.

b. The 3000 LMT requires 2 Marines to operate the unit.

2. Description of components:

a. Main Frame: Holds three modules, (pump module, control module and filter module). Additionally the main frame also consists of the following SL-3 components:

- (1) 1- tool kit
- (2) 3- 10'x 2" suction hoses
- (3) 3- 25'x 2" suction hoses
- (4) 1- 50'x 2" pump discharge hose
- (5) 1- 50'x 2" waste hose
- (6) 1- 50'x 1-1/2" fresh water hose
- (7) 1- 50'x 1-1/2" fire hose with nozzle
- (8) 1- 5- gal. polymer can assembly
- (9) 1- 2000 ml D.E. measuring container
- (10) 1- chlorine measuring container
- (11) 1- chlorine test kit
- (12) 1- suction strainer
- (13) 1- buoy
- (14) 1- collapsible priming bucket
- (15) 1- lifting sling (for helicopter lift)

b. Pump Module: Is suitable for a wide variety of fresh and saltwater applications. It is very corrosion resistant, made of bronze and stainless steel. The pump is a centrifugal, self-priming, lightweight, air cooled, single cylinder, 4 cycle overhead valve engine with direct fuel injection. It also:

- (1) is rated at 160 gpm
- (2) has 1 gal. capacity diesel fuel tank (0.4 GPH CONSUMPTION)
- (3) has 1 quart capacity (15-W-40) oil crankcase.

c. Control Module: Houses the diatomaceous earth tank, hypochlorinator tank, gauges, operating valves, ratio feeder adjusting knobs, and various piping systems.

(1) Diatomaceous Earth (D.E.) Slurry Tank: Stores the Diatomaceous earth slurry mixture. The diatomaceous earth is what actually filters the water. When the D.E. adheres itself to the filter, it is then called pre coat or filter cake.

NOTE: D.E. is any class of minute planktonic unicellular or colonial algae with silidified skeletons that form diatomite which is a light friable siliceous material derived chiefly from diatom remains and used especially as a filter.

(2) Chlorine Tank: Stores the chlorine slurry mixture. Chlorine is a disinfectant that kills bacteria in the water which in turn helps keep the water safe for consumption.

(3) Gauges: Monitor the operation of the 3000 LMT and indicates to the operator when the unit needs backwashing.

(4) Operating Valves: Routes the flow of water during various stages of operation.

(5) Chemical Feeders: Used to adjust the amount of chemicals introduced into the unit. The feeders measure on a scale of 0-10 with the optimum setting of 5.

d. Filter Module: Contains the filter segments on which the D.E. is layered. The grade of the D.E. and the consistency of the filter cake is what determines the filtering efficiency of the unit. The module also houses a compartment for D.E. storage.

3. Setup procedures:

a. Site selection:

- (1) Place the unit on firm level ground.
- (2) Upstream from water source.
- (3) Adequate cover and concealment.
- (4) Sufficient road nets (turnout and turnarounds).
- (5) Good drainage area.

b. Installation:

(1) Remove pump module and hoses from the main frame and set the pump within 25 ft. of the water source, but not more than 20 ft. above the water source.

(2) Connect suction strainer and buoy to the end of suction hose.

(3) Connect 2" suction hose to pump inlet.

(4) Connect 50'x 2" pump discharge hose from pump outlet to control module inlet.

(5) Connect 50'x 2" waste hose to the waste water discharge port located on the back of the control module, and set the other end of the hose at the drainage point

(6) Connect 50'x 1-1/2" fresh water hose to the fresh water discharge port located on the back of the control module and set end of hose near storage tanks. "Do Not" place fresh water discharge hose into storage tanks until required water tests have been performed.

c. Preposition valves and switches:

(1) Mix Polymer solution at the rate of (185 ml) or 6.3 fl oz. per 5 gallons of water. Attach the 3/4" quick adapter to the 5 gallon polymer can assembly.

(NOTE: Polymer creates a chemical reaction in which two or more small molecules combine to form larger molecules making filtration more efficient.)

(2) Set all control valves to the "Start Up" position (W-O-F-F-C-C).

(a) Clean Water Valve # 1 - Waste

(b) Waste Outlet Valve # 2 - On

(c) Backwash Valve # 3 - Filter

(d) Pre-coat Filter Valve # 4 - Filter

(e) D.E. Slurry Valve # 5 - Closed

(f) Chlorine Reservoir Valve # 6 - Closed

(3) Set all chemical feeders to "0".

(4) Close petcocks on top and bottom of the water motor.

(5) Close drain valve on Chlorine reservoir.

NOTE: If drain valves remain open, chlorine and D.E. tanks will over flow during operation.

NOTE: Wear dust mask when handling D.E. and dry chlorine.

(6) Mix 1 lb. or 16oz. bag of dry chlorine with 3 gals. of water and pour it into the chlorine tank avoiding the calcium deposits.

NOTE: An additional gal. of water will be added later in the operation.

(7) Close drain valve on D.E. tank.

(8) Load 5 measures each (2000Ml) of D.E. into the D.E. tank for a total of 10,000 Ml.

(9) Ensure D.E. clamp is secure and open D.E. vent.

(10) Connect the 2 quick disconnect hose fittings on the side of the control module to the Filter module.

(11) Ensure drain plug is in filter.

(12) Open the filter top vent valve.

d. Conduct Before Operation Checks and Services:

(1) Check for loose, missing, and broken bolts or nuts.

(2) The pump module:

(a) Open pump primer port to prime the pump with water. The pump can also be primed by removing suction strainer and pouring water, with a bucket through the suction hose.

(b) Check fuel level in tank: Fill with diesel if necessary.

(c) Check oil level: It must be between the min. and max. marks on the dipstick. Ensure it has the correct grade and viscosity for the operating temperature.

(d) Check the air cleaner cyclone: It should be free of sediment.

4. Startup procedures:

a. Put the automatic decompression device in the starting position by turning it clockwise until you hear an audible click then add $\frac{1}{4}$ turn. When properly set the knob will be at the 12 o'clock position.

b. Pull out extra fuel button if needed.

c. Set the speed regulating lever to full throttle position.

d. Insert the crank handle into the crank handle guide.

e. Crank the engine rapidly in a counterclockwise manner approximately eight times before compression is encountered and engine starts.

f. Remove crank handle from guide and properly clamp it to pump frame.

g. Run engine at full speed for 1 minute or until suction has occurred.

h. After suction has occurred, bring engine to half speed.

i. Close the filter vent valve once a steady stream of water flows from the vent hose.

j. Move valve # 4 to pre coat position and note the time.

k. Close the D.E. slurry vent valve once a steady stream of water flows from the vent.

l. Open the injector valves on each feeder head to ensure full pulsed water flow. The chlorine, D.E., and polymer bleeders are gray plastic components located behind the control module panel.

m. Open chlorine reservoir valve #6, until it fills up the tank to approximately 2" from the top, then close.

n. After approximately 8 minutes the filter should be observed through sight-glass for a good D.E. cake on the elements.

Adjust all three feeder heads to a setting of 5.

p. Set valve # 4 to "filter" position.

q. Set clean water valve # 1 to "clean water" position.

5. Conduct during operation checks and services:

a. Take chlorine samples from product hose and make adjustments as necessary to the chlorine feeder control knob.

b. Take NTU (Nephelometric Turbidity Unit) reading:

(1) Press on/off keypad to turn on meter.

(2) Fill beaker to a depth of at least 3 in. with product water.

(3) Completely immerse probe tip and cone assembly.

(4) Press RANGE keypad until best range is selected.

(5) NTU reading will be given on digital display.

c. If chlorine residual is 1.0 - 2.0, and NTU is 1.0 or less, the clean water hose can be placed in the storage tanks.

d. At 30 minute intervals, monitor the following:

(1) Chlorine level (1.0 - 2.0)

(2) NTU (1.0 or less)

(3) D.E. tank for slurry mixture: Remove the D.E. tank lid when liquid level reaches the low level mark. Add one 2000 ml measure of D.E. and fill with water. Do not run with the mixer blade exposed to air as the slurry mixture will be inhibited.

(4) Polymer feed tank level.

(5) Chlorine residual in treated water tank.

(6) Diesel fuel remaining.

(7) Yield of raw water source. For example: a pond, tank or reservoir.

(8) Monitor the following gauge readings:

- (a) Raw water pump suction gauge 15 vacuum to 15 psi.
- (b) Raw water flow gauge 15-35 gpm (on control module).
- (c) Raw water inlet gauge 0-35 psi (on control module).
- (d) Filter differential gauges.
 - 1 filter inlet gauge 0-40 psi.
 - 2 filter outlet gauge 0-18 psi.

e. Backwashing:

(1) The operator should backwash the system in the event of the following:

- (a) Filter differential pressure exceeds 18 psi.
- (b) NTU reading is above 1.0 for two consecutive readings.
- (c) Unit will be shut down for more than 8 hours.

(2) Before backwashing the system must be purged of D.E:

(a) Clean D.E. slurry tank:

1 Perform shutdown procedures on pump by holding throttle down to idle and engine comes to a complete stop.

2 Open the drain valve on bottom of the slurry tank (for approximately 5 minutes to fully drain).

3 Set D.E. feeder to "10".

4 Open D.E. injector.

5 Position valves in start up position(WOFFCC)

6 Perform startup procedures on pump.

7 After suction occurs set pump at half throttle.

8 Operate pump until water jet is clear from D.E. injector.

9 Close drain valve, D.E. injector and set all feeder heads to "0".

NOTE: If D.E. tank overflows close D.E. drain.

NOTE: Backwash A and B will be done to perform a backwash.

(b) Set the control valves to the "Backwash-A" settings:

- 1 Clean water valve # 1 - Waste
- 2 Waste outlet valve # 2 - Off
- 3 D.E. Slurry valve # 5 - Open
- 4 Backwash valve # 3 - Backwash

(c) After one minute set the control valves to the "Backwash" settings. Valve #3 will alternate from "Filter" to "Backwash" every 15 seconds, while gently shaking the filter module. Complete this process 4 times.

6. Shut down procedures:

a. The operator should perform a short shutdown of the system in the following events:

- (1) The raw water level is low.
- (2) Product water tanks are full.
- (3) There is an interruption in the normal operation cycle.
- (4) When the unit will be shutdown for less than 8 hours.

b. The procedures for short shutdown are as follows:

- (1) Set the control valves to the "shut down" positions:
 - (a) Ensure that Backwash valve # 3 is on "Backwash".
- (2) Stop the engine as follows:
 - (a) Let the engine idle for a short period.

(b) Keep the speed regulating lever in stop position until the engine has come to a complete stop.

NOTE: To restart the unit perform startup procedures. Check D.E. cake on filter. If D.E. cake is adequate, start filtering process.

c. The operator should perform a long shutdown of the system in the following events:

- (1) To secure the system for more than 8 hours.
- (2) Prior to termination of the field exercise.
- (3) For extended storage or transportation.

d. Procedures for long shutdown are as follows:

- (1) Perform short shutdown.

(2) Clean chemical reservoirs.

(a) Open drain valves on the D.E. and chlorine tank.

(b) Set chemical feed heads to "10".

(c) Position valves in start up position

(d) Open injectors.

(e) Perform startup procedures on pump. (After suction bring to half throttle)

(f) Run the system for 3 to 5 minutes until clear jet of water comes out of injectors.

(g) Close drain valves, chemical injectors, and set all feeder heads to "0".

(3) Perform backwash.

(4) Shut the system down.

e. Perform open filter housing washdown:

(1) Drain the filter by removing the drain plug located at the bottom of the filter housing.

(2) Remove the filter clamp.

(3) Remove the upper filter half assembly.

(4) Disconnect the 2 quick disconnect hose fittings that connect the control module to the filter module and plug the upper filter hose.

(5) Set valves to the following positions:

a Valve # 1 - Waste

b Valve # 2 - On

c Valve # 3 - Backwash

d Valve # 4 - Filter

e Valve # 5 - Close

f Valve # 6 - Close

(6) Restart the pump, using water from the best available source.

(7) With pump at full speed, move Waste Outlet valve #2 to - "Off" position.

(8) Using the sampling hose, wash down the complete system.

NOTE: Do not allow the system to operate at maximum power for more than two minutes at a time without water flowing from either the sampling hose or from the waste outlet valve #2, otherwise damage will occur from high pressure.

(9) Let the engine idle for a short period then keep the speed regulating lever in stop position until the engine has come to a complete stop.

7. After operation checks and services:

a. Check oil level in crankcase at least once per day. Change every 100 hours of operation along with the oil filter.

b. Check the air filter and cyclone, the air filter should be replaced every 1000 hours of operation or when ever dirty.

c. Replace fuel filter every 2000 hours of operation.

8. Disassembly and storage:

a. Drain all hoses and equipment.

b. Clean unit and repack unit.

REFERENCES: TM-09777A-14/1
TM-01034D-12&P1